A New Troglobitic Crayfish from Florida

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With the discovery of the new species described herein from a well in Dade County, Florida, seven troglobitic crayfishes, representing three genera, are known to occur within the state. The monotypic genus *Troglocambarus* is endemic in the karst area of the peninsula. The genus *Cambarus*, of which there are six or perhaps seven troglobites (*C. cahni* is a questionable troglobitic species; Hobbs and Barr, 1960), is represented by only one Floridian species in Jackson County and southwestern Georgia, the remaining members frequenting subterranean waters of Alabama, Arkansas, Missouri, and Tennessee. Five of the eight known spelean species and subspecies of the genus *Procambarus* are Floridian endemics; the other three occur in Alabama, Cuba, and Mexico. Only one other crayfish genus, *Orconectes*, is represented among the troglobitic crayfishes, and six species and subspecies belonging to it are found in the limestone area extending from northern Alabama to southern Indiana (Hobbs and Barr, in press).

To aid in the recognition of the troglobitic crayfishes of Florida, a key to those occurring in the State is appended to the description of the new species. Summaries of our knowledge of the previously described Floridian species are recorded by Hobbs, 1942b, 1958; Hobbs and Barr, 1960; and Warren, 1961.

All of the specimens of the new troglobite were obtained from a trap at the outlet of a motorized pump at the Little Bird Nursery in Miami and were forwarded to me by Billy R. Drummond and George C. Miller, who together with Henry De Maine and David Burton, former and present proprietors of the nursery, became interested in the animals, including amphipods and isopods, which appeared in the trap. I wish to thank these gentlemen for permitting me to describe this crayfish which is named in honor of Mr. Miller, a long-time friend and fellow student of crayfishes. I am also grateful to him and to Fenner A. Chace, Jr. for their criticisms of the manuscript. Finally, I acknowledge, with appreciation, the gift of three specimens (1 ♂ I, 1 ♂ II, 1 ♀) of *Procambarus pallidus* from Suwannee County by William F. Smith-Vaniz. These specimens were collected by him from an un-named sink in the Peacock

Slough system, three miles east of Lauraville, and serve further to close the gap in the apparent discontinuous range of the species.

Procambarus milleri, new species

Diagnosis. Body without pigment, eyes large but with pigment confined to small, faceted, distal disc. Rostrum without marginal spines or tubercles, and base of acumen continuous with rostral margins. Areola 33-36.6 per cent of entire length of carapace, and five to six times longer than wide. Cervical spines lacking. Suborbital angle rudimentary. Postorbital ridges lacking tubercles or spines. Antennal scale approximately 2.3 times longer than wide, broadest about midlength. Mesial surface of palm of chela with irregular row of 9-11 tubercles, and both fingers provided with moderately well developed longitudinal ridges. Ischia of third and fourth pereiopods with simple hooks. First pleopods asymmetrical with rounded shoulder on cephalic surfaces, provided with subterminal setae, and reaching cephalad to coxae of second pereiopods; distal extremity bearing (1) long, slender, sinuous mesial process reaching clearly beyond other terminal elements, (2) slender, moderately long cephalic process arising from cephalomesial surface and extending distally almost as far as tip of central projection, (3) corneous, distally-directed, lanceolate central projection arising from cephalomesial surface of caudal knob, and (4) prolonged rounded caudal knob, caudal process lacking. Adult female unknown.

Holotypic Male, Form I. Body subovate, compressed laterally. Abdomen narrower than thorax (5.2 and 5.7 mm). Width of carapace less than height at caudodorsal margin of cervical groove (5.7 and 6.5 mm). Areola 6.0 times longer than wide with two or three punctations across narrowest part. Cephalic section of carapace 1.7 times as long as areola (length 36.6 per cent of entire length of carapace). Rostrum excavate dorsally with unthickened convergent margins lacking spines or tubercles; upper surface of rostrum concave with usual submarginal row of setiferous punctations and others between; acumen not delimited basally. Subrostral ridges moderately well developed but evident in dorsal aspect only in caudal orbital region. Postorbital ridges moderately prominent, grooved dorsolaterally, and lacking spines or tubercles. Suborbital

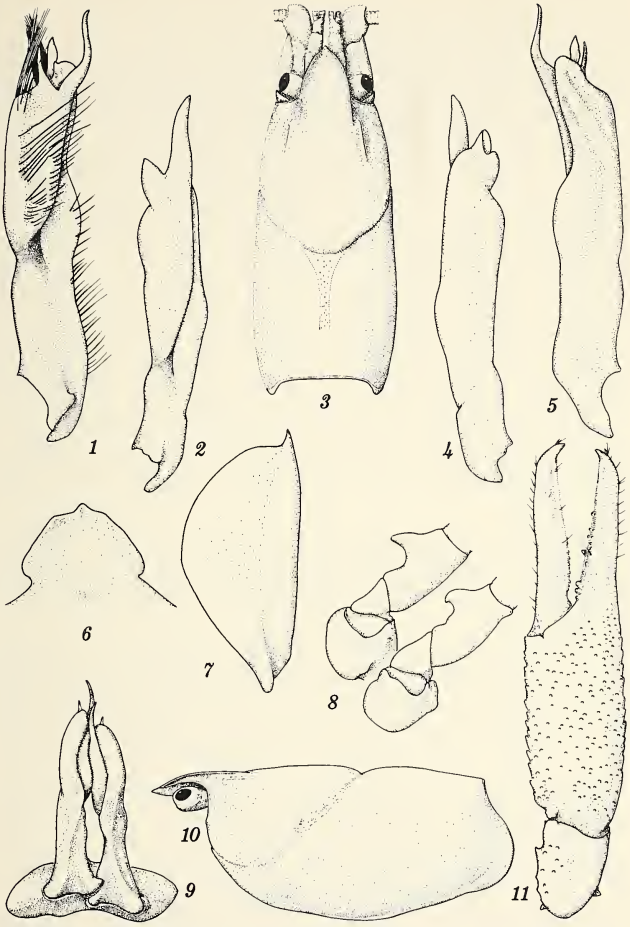
TABLE 1

Measurements (mm) of *Procambarus milleri*

	Holotype	Morphotype
Carapace:		
Height	6.5	3.8
Width	5.7	3.5
Length	13.1	7.8
Areola:		
Width	0.8	0.3
Length	4.8	2.6
Rostrum:		
Width	2.4	1.3
Length	2.8	1.9
Right Chela:		
Length of inner margin of palm	6.2	2.2
Width of palm	3.5	1.9
Length of outer margin of chela	13.7	5.2
Length of dactyl	6.6	2.6

angle and branchiostegal spine almost obsolete. Carapace punctate dorsally and weakly granulate laterally, cervical spines and enlarged cervical tubercles lacking. Abdomen longer than carapace (15.2 and 13.8 mm). Cephalic section of telson with three spines in each caudolateral corner. Cephalic portion of epistome (Fig. 6) somewhat resembling isosceles rhomboid with small cephalomedian projection, mostly plane with slightly elevated (ventrally) margins. Antennules of usual form with moderately prominent spine on ventral surface near midlength. Antennae broken but probably extending caudad at least as far as telson. Antennal scale (Fig. 7) 2.3 times longer than wide, greatest width about midlength, with lamellar area much broader than thickened lateral portion; latter terminating in comparatively short spine.

Right chela (Fig. 11) elongate, subovate in cross section, not strongly depressed. Mesial surface of palm with irregular row of 11 tubercles, lateral margin with subserrate row of tubercles, and upper and lower surfaces tuberculate; lower surface with prominent tubercle distolateral to articular condyle at base of dactyl. Fixed finger with submedian longitudinal ridge dorsally and ventrally, both flanked by setiferous punctations; opposable margin with two rows of tubercles, dorsal one consisting of 11 situated along proximal three-fifths of finger with third from base largest,



Figs. 1-11. *Procambarus milleri,* new species. (Setae omitted from all structures illustrated except in Figs. 1 and 11; Figs. 2 and 4 are from morphotype, all others from holotype). Figs. 1 and 2, mesial views of first pleopods; Fig. 3, dorsal view of carapace; Figs. 4 and 5, lateral views of first pleopods; Fig. 6, epistome; Fig. 7, antennal scale; Fig. 8, basal podomeres of third and fourth pereiopods; Fig. 9, caudal view of first pleopods; Fig. 10, lateral view of carapace; Fig. 11, dorsal view of distal podomeres of right cheliped.

ventral row of four tubercles, most proximal largest, situated along middle half of finger, minute dentieles studding surface between and distal to tubercles. Dactyl with weak dorsal and ventral submedian longitudinal ridges flanked by setiferous punctations; mesial surface with row of similar punctations; opposable margin with single row of nine small tubercles along proximal half of finger, larger one below row between level of fourth and fifth tubercle, and with minute dentieles interspersed between tubercles and extending almost to corneous tip of finger.

Carpus of right cheliped longer than broad (3.5 and 2.4 mm) with mesial and dorsomesial surfaces tuberculate, and dorsolateral, lateral, and ventral surfaces mostly punctate; dorsal surface with shallow oblique depression; mesial surface with one conspicuously large, subacute tubercle, three smaller ones proximal to it, and one small one dorsodistally; lower distal margin with two spiniform tubercles, lateral one on ventrolateral articular condyle, and other, more mesially situated, with several smaller tubercles proximomesial to it.

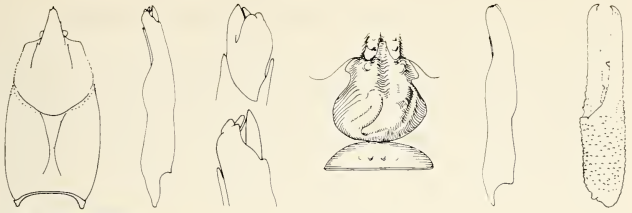
Merus of right cheliped punctate laterally, otherwise tuberculate; marginal ventral tubercles arranged in mesial and lateral rows of approximately 14 tubercles each. Ischium with three small tubercles.

Hooks on ischia of third and fourth pereiopods (Fig. 8) simple, extremities of neither approximating distal margin of corresponding basis. Coxa of fourth pereiopod inflated caudomesially but lacking distinct boss; that of fifth pereiopod with very prominent, caudomesial, oblique prominence compressed in longitudinal plane of body.

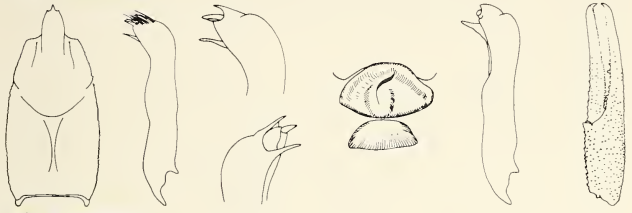
Sternum between second, third, and fourth pereiopods moderately shallow and bearing heavy fringe of setae on ventrolateral margins.

First pleopods (Figs. 1, 5, 9) as described in diagnosis.

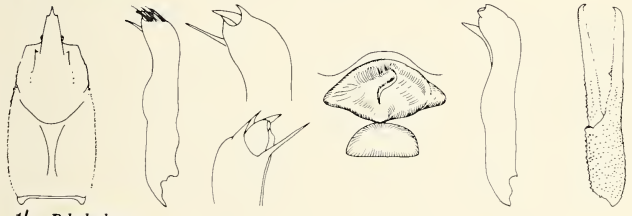
Morphotypic Male, Form II. Differs from holotype in following respects: rostrum more strongly acuminate; cephalic section of telson with only one spine in each caudolateral corner; mesial margin of palm of chela with only nine tubercles; opposable margin of fixed finger with only two prominent tubercles and that of dactyl with one; ventral surface of merus of cheliped with six or seven tu-



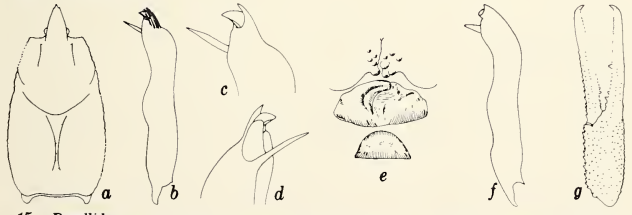
12. P. acherontis



13. P. l. lucifugus



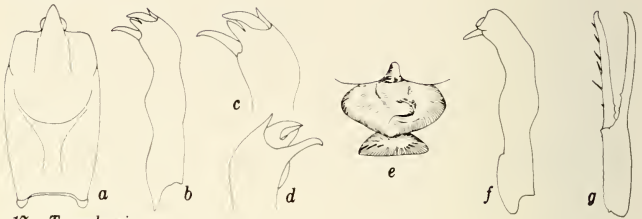
14. P. l. alachua



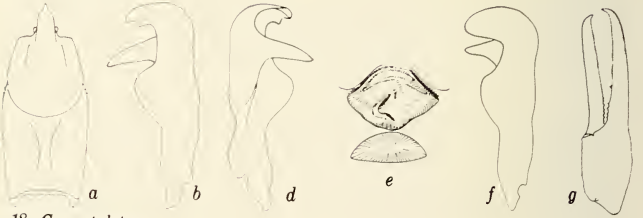
15. P. pallidus

Figs. 12-15. Floridian troglobitic crayfishes. (Setae omitted from all structures illustrated except subterminal ones on b). a, dorsal view of carapace; b, lateral view of first pleopod of first form male; c, mesial view of distal portion of same; d, lateral view of distal portion of same; e, annulus ventralis; f, lateral view of first pleopod of second form male; g, dorsal view of chela of first form male.

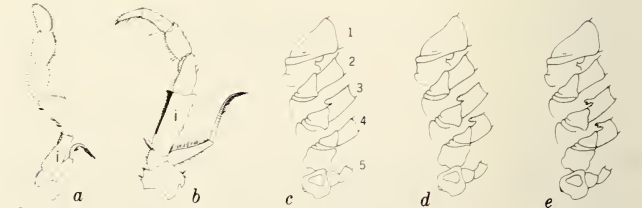
16. *P. milleri*



17. *T. maclanei*



18. *C. cryptodytes*



19.

bercles in each row; ischia of third and fourth pereiopods with scarcely trace of hooks. See measurements.

First pleopods (Figs. 2, 4) much more nearly symmetrical than in holotype and with oblique suture near base. Terminal elements non-corneous, proportionately larger and heavier (except for caudal knob), but situated and directed as their counterparts in holotype.

Type-locality. Well at Little Bird Nursery and Garden Store at 8427 Bird Road, Miami, Dade County, Florida (Sec. 15, Twp. 54S, R. 40E). The well is 22 feet in depth and is provided with an 18 foot casing.

Types. The holotypic male, form I (No. 131257), and morphotypic male, form II (No. 131258), are deposited together with the paratypes (five males, form I, seven males, form II, three juvenile males, and one juvenile female) in the National Museum of Natural History, Smithsonian Institution.

Size. The largest first form male, the holotype, has a carapace length of 13.8 mm; the smallest, 8.0 mm.

Range. Known only from the type-locality.

Variations. All variations noted are minor ones, most associated with the degree of maturity of the specimens; none is so marked as to confuse this crayfish with any previously described species.

Relationships. Procambarus milleri has its closest affinities with *P. alleni* (Faxon, 1884; p. 110), one of the two epigean crayfishes known to occur in the southern part of the peninsula. The close relationship existing between the two is clearly demonstrated in the similarities between the first pleopods of the males. The long sinuous mesial process and the rounded, distally tapering shaft of the appendage constitute a combination of characters which exists in no other crayfishes. There can be no doubt that the two have had a common ancestry, and it is entirely possible, if not probable, that the troglobite was derived comparatively recently from a stock

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Figs. 16-19. Floridian troglobitic crayfishes. (Setae omitted from all structures illustrated except subterminal ones in 16-18b and 19a,b. Except for 18d and 19, see explanation for Figs. 12-15). Fig. 18d, mesial view of first pleopod of first form male. Fig. 19a, caudal view of third maxilliped of *T. maclanei*; Fig. 19b, caudal view of third maxilliped of *P. pallidus*; Fig. 19c-e, diagrams of basal podomeres of left pereiopods of male with ischia stippled; c, hook on ischium of third pereiopod; d, simple hooks on ischia of third and fourth pereiopods; e, bituberculate hooks on ischia of third and fourth pereiopods. "i" in 19a, b=ischium.

of *P. alleni* which found its way into the subterranean channels of the oolitic limestone of the southern part of the peninsula.

Despite the marked similarity between the two, *P. milleri* may be distinguished readily from *P. alleni* by its albinistic quality, the absence of marginal spines or tubercles on the rostrum, and the small size at which it attains sexual maturity. It may be distinguished from all other troglobitic crayfishes by the structure of the first pleopod of the male, the only one in which the mesial process is sinuous and directed distally.

Life History Notes. First form males were collected in February, March, and May. The holotype was collected on May 2, 1968 when it was in the first form. It was placed in an aquarium where it molted on October 22 to second form, increasing its carapace length only 0.4 mm. It molted again on November 25, returning to the first form, with an increase in carapace length of 1.2 mm. It died on March 17, 1969. These observations were made by Mr. Miller who preserved the exuvia. The latter are deposited with the holotype.

Second form males were obtained in January, February, March, July, and August. The only female that has been found is a juvenile taken on January 24, 1968.

Key to the Troglobitic Crayfishes of Florida

1 Third maxillipeds lacking teeth on opposable border of ischium (Fig. 19a) *Troglocambarus maclanei* Hobbs, 1942a, p. 345
(Caves from Citrus and Hernando to Alachua counties)

1′ Third maxillipeds with teeth on opposable border of ischium (Fig. 19b) 2

2 Males with hooks on ischia of third pereiopods only (Fig. 19e); first pleopod with two terminal elements bent at right angles to main shaft of appendage (Fig. 18b, d,f). Females with annulus ventralis fused to sternum immediately cephalic to it, never overhung (ventrally) by tuberculate processes from sternum (Fig. 18e) *Cambarus cryptodytes* Hobbs, 1941, p. 110
(Caves and well in Jackson County, Florida and Decatur County, Georgia)

2′ Males with hooks on ischia of third and fourth pereiopods (Fig. 19d,e); first pleopod with three or four terminal elements, never with all bent at right angles to main shaft of appendage (Figs. 12-16b-d,f). Females with distinct flexible membrane separating annulus ventralis from sternum immediately cephalic to it, or membrane obscured by multitubercule processes projecting caudally from sternum (Figs. 12-16e) 3

3 Eye with pigment spot (Figs. 14,16a) 4

3′ Eye without pigment (Figs. 12,13,15a) 5

4 Pigmented area of eye faceted; rostrum without marginal spines or tubercles.

Males with first pleopod bearing distally directed mesial process (Fig. 16b-d,f). Female unknown *Procambarus milleri*, new species
(Well in Dade County)

4′ Pigmented area of eye lacking facets; rostrum with marginal spines or tubercles. Males with first pleopod bearing caudodistally directed mesial process (Fig. 14b-d,f). Females with cephalic margin of annulus ventralis gently rounded, and lacking longitudinal, cephalomedian trough (Fig. 14e)
Procambarus lucifugus alachua (Hobbs, 1940, p. 402)
(Caves and sinkholes in Alachua and Gilchrist counties)

5 Rostrum narrower at base than near midlength. Males with distal portion of first pleopod bent caudad at about 80 degrees and cephalic process directed at angle of approximately 70 degrees to main axis of appendage (Fig. 13b-d,f). Females with sternum immediately cephalic to annulus ventralis devoid of tubercles (Fig. 13e)
Procambarus lucifugus lucifugus (Hobbs, 1940, p. 398)
(Caves from Citrus and Hernando counties northward to Marion County where it intergrades with *P. l. alachua*)

5′ Rostrum tapering from base. Males with distal portion of first pleopod straight or bent caudad no more than at 45 degree angle and cephalic process, if present, directed at angle of about 35 degrees to main axis of appendage (Figs. 12, 15b-d,f). Females with sternum immediately cephalic to annulus ventralis bearing tuberculate prominences sometimes overhanging (ventrally) cephalic portion of latter (Figs. 12,15e) 6

6 Males with hooks on ischia of third and fourth pereiopods bituberculate (Fig. 19e); first pleopod lacking subterminal setae and cephalic process, and mesial process directed distally, not reaching bases of other terminal elements (Fig. 12b-d,f). Females with annulus ventralis as long as, or longer than, broad and bearing shallow, longitudinal, cephalomedian trough (Fig. 12e) *Procambarus acherontis* (Lönnberg, 1895, p. 6)
(Spring and well in Seminole County)

6′ Males with hooks on ischia of third and fourth pereiopods simple (Fig. 19d); first pleopod with subterminal setae and well developed cephalic process, and mesial process directed caudodistally, clearly reaching level of bases of other terminal elements (Fig. 15b-d,f). Females with annulus ventralis approximately one-half as long as broad and lacking cephalomedian trough (Fig. 15e)
Procambarus pallidus (Hobbs, 1940, p. 394)
(Caves and sinkholes in Alachua, Columbia, Suwannee, Leon, and Wakulla counties. Specimens from the latter two are juveniles and are tentatively assigned to this species.)

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